Lesson 5

Saving Humpty Dumpty, Part 2

Focus

To reinforce concepts of shock absorption/energy return of various sports surfaces and of how controlled variables help establish clearer relationships between cause and effect.

Concepts

- Materials have different properties and vary in their abilities to absorb forces or return energy.
- Products undergo scientific testing to determine how to reuse and recycle them.
- Using controlled variables in experiments to test products helps establish clearer relationships between cause and effect.

Learning Objective

Students

- investigate the shock absorption/energy return of given surfaces.

Prep Time

10–20 min Gather materials for experiment.

5 min Make copies of instructions for testing procedure.

5 min Make overhead transparency of data graph from lab report.

5 min Set up VCR for Reuse-A-Shoe video.

Class Time

45 min

Teacher Tip

Pick a nice day: your students will conduct this experiment outdoors. Students can work in the same groups as in the previous lesson.

If you're using hardboiled eggs, you'll need lots – encourage students to recycle eggs by eating egg salad, egg salad sandwiches, etc. Prepare poster tubes for each group in advance to save time.

You may want to make the Nike video Reuse-A-Shoe available.

background

The U.S. Consumer Product Safety Commission (CPSC) reports that about 200,000 children are treated in U.S. hospital emergency rooms for playground equipment-related injuries each year. Most injuries result from falls (in 2004, the National Safe Kids Campaign reported that while 10% of injuries involve falls onto equipment, nearly 70% of these injuries involve falls to the playground surface itself).

According to the CPSC, most playground surfacing materials are tested and rated by their shock-absorbing ability. Safe playgrounds are characterized by surfaces that offer lots of shock protection and little energy return.

In this lesson, students test three surfaces for cushioning, or shock-absorption, properties:

- an asphalt parking lot, which serves as a playground in many urban schools;
- their own playground; and
- the sports surface the students made from recycled shoe materials in the previous lesson.

Subject Areas:

Science

Math

Skills:

Inquiry and investigation, measuring and recording data on charts and tables, drawing conclusions, evaluating results

Materials:

Overhead projector
Transparency of data graph from lab report
Reuse-A-Shoe video
For each group
- Students' science notebooks
- Lab Report Worksheets from previous lesson
- Instructions for Testing Procedure (see cards at end of lesson)
- Sports surface model the group created
- 6 hard-boiled eggs (without cracks) or substitute such as water balloons – something relatively lightweight and delicate that cannot withstand a great shock. If using water balloons, use same size balloons and equal amounts of water in each. Also note that shredded water balloons can cause problems for wildlife due to possible ingestion of material. If you use this material option, please teach children to do a thorough and careful clean-up.
- Open tubing (see demonstration tube, lesson 5, part 1, and instructions)

Key Vocabulary:

cushioning/shock absorption, drop height (the height above the surface system from which the test object is released)

Procedure

1. Explain that today students will test their experimental playground surface and two other surfaces (asphalt, and a playground at their school) to compare each surface's cushioning properties.

2. Go over the **lab report worksheet** (Student Worksheet, "Saving Humpty Dumpty," from previous lesson) with them, especially the data tables, pointing out that each group will complete the test for asphalt/playground surfaces and for the playground fall protection surface they made. One group functions as the control group. Have each group note which data columns they will be using.

3. Ensure that the students have their lab worksheets, science notebooks, manufactured sports surface, testing materials, and instructions for the testing procedure. Remind them to verify which students are taking on the specified jobs of leader/organizer, recorder, set-up/clean-up, and spokesperson.

4. Take the students outside and let them conduct the experiments. Have them complete the data charts as they do each test.

Evaluation/Wrap-Up

5. Now work with the students, using the data graph, to graph the results of the drop test on the overhead projector. (Students should do likewise.) Have students discuss in their groups the analysis section of their report, and then have them complete the rest of the lab report.

6. Have all students answer the following questions in their science notebooks:
   - According to the data from the drop height test, which of the surfaces offered the greatest amount of cushioning?
   - What material, or combination of materials, appears to provide the best cushioning ability?
   - What other uses can you suggest for this product?

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Enrichment

Choose from the following activities:

1. Show the Nike video Reuse-A-Shoe.

2. Design an experiment to double the cushioning ability of the model sports surface you created.

3. Explore the effect of density on shock absorption/energy return by compressing the sports surface material (as it dries) with a weight. Using the drop test, measure and record what happens to an object dropped on this compressed surface. What conclusions can you make about how density affects energy return? What applications might these conclusions have in the sports industry?

4. Conduct the same experiment using a wooden baseball bat to discover the "energy return" of given sports surfaces. Measure the amount of "rebound" by holding a meter stick behind the baseball bat and noting how far "up" the bat bounced. Then answer the following questions:
   - Which test surface absorbed the most energy?
   - What would you expect to happen if you dropped a basketball on each of the test surfaces?
   - Why is a bat made out of hard material?

5. (Advanced) Research the connection between shock absorption of surfaces and speed. For example, think of a runner who runs on a track, on sand, on concrete. Imagine running across a mile-long trampoline, or on a mattress. Is one surface "faster" than another? Why/why not?

Resources

For more information on action and reaction forces, students can consult the book *Sports Science for Young People*, by George Barr (New York: Dover Publications, 1990 and 1962). Barr presents interesting and clear information about the physics concepts in sports, such as why a basketball bounces, and how young people can improve their sports performance by letting science work **for** instead of **against** them.

The book, *More Science Experiments for You: 112 Illustrated Experiments*, by Bob Brown (Summit, PA: TAB Books, 1988) also includes an experiment involving action and reaction forces.

The website Playground Safety Initiative offers information and seminars about playground safety in Canada and the U.S. Find it here: *http://www.cpra.ca/npsc/npsc.htm*.

The National Playground Safety Institute offers information and certification courses for playground safety inspectors. Find out more here: *http://www.uni.edu/playground/home.html*.

The Consumer Products Safety Commission has pamphlets and reports about playground and other product safety issues at *http://www.cpsc.gov/cpscpub/pubs/pub_idx.html*.

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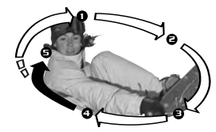
Student Worksheet



TESTING SHOCK ABSORPTION

Instructions for Testing Procedures

Materials:

- 6 eggs or water balloons (you will use 2 per test surface)
- 2 1-meter measuring sticks or 2-meter tape measure
- posterboard testing tube

Test surfaces:

- an "asphalt" surface
- your own playground at your school
- sports surface model your group created

Description of test:

You'll drop an object from increasing heights at increments of .25 meter. The test will help you determine the materials that have the best combination of cushioning properties.

Procedure:

For asphalt and playground areas

1. Cover the surface to be tested with a plastic bag or sheet.

2. Drop the object from .25 meters. If it did not break, repeat at .50 meters, .75 meters, 1.0 meters, and so on until the object breaks.

3. Record the height from which the object was dropped when it broke.

4. Repeat the procedure twice for each surface and average the break height.

For sports surface model

1. Place the surface on the asphalt or grassy area.

2. Position the tube vertically on the test surface (if you're using eggs or water balloons – if not, skip to the next step). The tube must fit inside the water jug so that it can hold the egg and keep it from rebounding onto the hard surfaces and breaking.

3. Drop the object from .25 meters. If it did not break, repeat at .50 meters, .75 meters, 1.0 meters, and so on until the object breaks.

4. Record the height from which the object was dropped when it broke.

5. Repeat the procedure and average the break height.

Barrett Christy:

"We all need to work to keep our planet healthy and strong."